C N S / A T M for Naval Aviation

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Volume 2, Issue 2, April 27, 2000

Purpose

This newsletter provides information to the Naval aviation community concerning requirements, issues, and developments in Communications, Navigation and Surveillance / Air Traffic Management (CNS/ATM).

COMMUNICATIONS

CPDLC Part II

[This article continues the discussion of Controller Pilot Data Link Communications (CPDLC) began in Volume 1, Issue 5, CNS/ATM for Naval Aviation (October 22, 1999)]

CPDLC is expected to reduce controller and pilot workload, and to increase safety by providing more order and less stress for controllers. Also, it will reduce aircraft holds and delays, and will provide more timely effective issuance of clearances. CPDLC will speed up transmission of information while reducing communications errors. A simulation test of CPDLC showed a more than 40% reduction in the number of controller voice messages, a more than 60% reduction in spectrum occupation time, and increased message comprehension. It is anticipated that CPDLC will significantly reduce traffic congestion. In simulations, the FAA increased the capacities of simulated sectors by as much as 40% using CPDLC.

Implementing CPDLC may lead, however, to degrading situational awareness in at least two areas. There will be increased pilot "head down time" to handle CPDLC communications, and a loss of the "party line" which provides important information such as turbulence, holding patterns or weather.

Operational for more than two decades, civil aeronautical data links are used for Aeronautical Operational Control (AOC) communications between the aircraft and the aircraft's operational organization. The principal data link is the Aircraft Communications Addressing and Supporting System (ACARS). ACARS is available worldwide through the ARINC and SITA VHF networks. ACARS messages that are passed from the aircraft to an Airline's AOC include the OOOI series of out, off, on, and in. Messages for delay, position, weather reports, crew, fuel, engine data, and maintenance information are also passed over ACARS to the AOC. AOCs use ACARS to pass to the aircraft weight and balance information, flight plan, weather, gate assignments, airport analysis, load, voice request, passenger and crew information, among other data.

The FAA expanded ACARS usage in the early 90's to include some Air Traffic System (ATS) functions such as Pre-departure Clearances (PDC) and Digital Automated Terminal Information Services (D-ATIS), Data Link Delivery of Expected Clearances (DDTC), and Terminal Weather Information for Pilots (TWIP). These capabilities are now available at many US domestic airports.

The first civil use of a data link for actual aircraft-controller communications was the Future Air Navigation System (FANS) - in use in the Pacific. The FANS-1/A implementation uses the INMARSAT satellite for beyond line of sight communications, and ACARS for line-of-sight communications. FANS-1/A is now being introduced into the Oakland oceanic area, the New York oceanic area, and is one of three data links being used in the Preliminary Eurocontrol Test of Air/Ground Data Link (PETAL) II trials in Europe.

VHF Data Link Mode 2 (VDL-2) was developed as a digital data only link to replace analog ACARS to increase data throughput, and provide a VHF data link compatible with the emerging Aeronautical Telecommunications Network (ATN). The FAA decided to develop Domestic CPDLC using VDL-2 and eventually implement VDL-3 that has both digital voice and digital data capabilities. The FAA is implementing Domestic CPDLC in phases, known as builds. Builds I, IA and II will use VDL-2, while Build III will use VHF Data Link Mode 3 (VDL-3).

By May 2000, the FAA will link Domestic CPDLC controller and flight deck simulators together. This year's testing will focus on end-through-end tests at the FAA's William J. Hughes Technical Center, Atlantic City, N.J. Initial simulations are focusing on flight crew and ground crew procedures, which have already received some refinement from previous tests. Testing will evaluate human-computer interfaces to ensure that controllers and pilots are on the same "sheet of music."

The IOC for Domestic CPDLC Build I is projected for June 2002 at the Miami Air Route Traffic Control Center (ARTCC), with active participation by American Airlines. CPDLC Build I is intended to develop basic operational procedures and not to demonstrate the ultimate capacity increases expected with

CPDLC. Build I message capabilities are routine, repetitive and non time-critical, and do not include messages to alter the flight path. The only downlink message is the initial contact voice message alerting the controller of the aircraft's presence. (Downlink refers to messages from the aircraft to the ground, while uplink refers to messages from the ground to the aircraft.)

Following CPDLC Build I, CPDLC Build IA adds additional messages. According to the FAA, Miami will also be the first equipped with Build IA with the IOC projected for June 2003. National (ground) deployment of CPDLC Build IA will occur in January 2004 through January 2006. CPDLC-IA adds pilot-initiated altitude requests, controller assignment of speeds, headings, altitudes, and a route clearance function to the CLDLC-I message set.

In Europe, an effort similar to Domestic CPDLC is taking place with the PETAL trials. The FAA is coordinating development of Domestic CPDLC with Eurocontrol with an ultimate goal of commonality in Europe and in the US. American Airlines plays an important role by participating in both the European and the US trials.

The message descriptions in the following tables are the planned implementation of Build I:

Build I Messages:

Uplink Messages for CPDLC Build I:

Contact/Monitor/Surveillance Requests (uplink)
➢ CONTACT *(unit name) (frequency)*
➢ MONITOR *(unit name) (frequency)*

Report/Confirmation Requests (uplink)
➢ CONFIRM ASSIGNED LEVEL

Air Traffic Advisories (uplink)
➢ *(facility designation)* ALTIMETER *(altimeter)*
➢ CHECK STUCK MICROPHONE *(frequency)*

System Management Messages (uplink)
➢ ERROR *(error information)* [System generated error message.]
➢ NEXT DATA AUTHORITY* *(facility)*
➢ SERVICE UNAVAILABLE [from the ground]
➢ LOGICAL ACKNOWLEDGEMENT**
➢ USE OF LOGICAL ACKNOWLEDGEMENT** PROHIBITED

Additional Messages (uplink)
➢ *(free text)* (four types)

Downlink Messages for CPDLC Build I

Responses (downlink)
➢ WILCO
➢ UNABLE
➢ STANDBY
➢ ROGER
➢ AFFIRM
➢ NEGATIVE

Reports (downlink)
➢ ASSIGNED LEVEL *(flight level)*

System Management Messages (downlink)
➢ ERROR *(error information)*
➢ NOT CURRENT DATA AUTHORITY*
➢ CURRENT DATA AUTHORITY*
➢ NOT ACKNOWLEDGED NEXT DATA AUTHORITY*
➢ LOGICAL ACKNOWLEDGMENT**

*The Current Data Authority is the Air Traffic System (ATS) unit able to exchange CPDLC messages with the aircraft. The next (adjacent) ATS unit to communicate with the aircraft by CPDLC is known as the Next Data Authority. The aircraft avionics does not recognize a Next Data Authority until nominated by the Current Data Authority in a NDA message.

**A Logical Acknowledgement is a system-generated message. It confirms that the receiving system has successfully received an incoming message. The message then can be displayed to the responsible person if display is required. A Logical Acknowledgement does not replace any required operational response by a pilot or controller.

Pilots normally will not have to type messages, but select responses from a menu, and enter appropriate data such as flight level, airspeed, etc. If the pilot responds "STANDBY" to an incoming request, the transaction is kept open. If the pilot responds with WILCO, UNABLE, AFFIRMATIVE, NEGATIVE or ROGER, the transaction is closed. Additionally, if the ground receives an error in the pilot's response, the transaction is closed.

Information concerning the VDL-2 implementation of CPDLC can be found at the FAA's Aeronautical Data Link Web Site, http://38.243.118.34/. The European PETAL 2 website, http://www.eurocontrol.be/projects/eatchip/petal2/, also provides information. RTCA Paper No. 064-00/SC194-015 (Draft) *Minimum Human Factors Standards for Air Traffic Services Provided Via Data Communications Utilizing the ATN, Builds I and IA* of 16 March 2000 was referenced in this news letter. An article by Heather Orlestsky Milke in Avionics Magazine, April 2000 titled, "CPDLC Over Miami" (pp S1-S7) was also referenced for this newsletter. Also helpful is the information on FANS-1/A CPDLC is available at http://www.mpx.com.au/~cjr/cpdlc.htm.